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Nuclear Evidences for Confirming the Physical Existence of 585 GeV Weak Fermion and Galactic Observations of TeV Radiation

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Abstract: **Background**: In our recent publications pertaining to 4G model of final unification and based on strong and electroweak interactions, we have proposed the existence of a weak fermion of rest energy 585 GeV. **Objective**: To confirm the physical existence of the proposed 585 GeV weak fermion by analyzing weak and strong interactions in a unified approach via 4G model of final unification, super symmetry and string theory. **Method**: Considering the proposed nuclear charge of 2.95*e*, proton, electron mass ratio, specific charge ratios of proton and electron, Fermi's weak coupling constant, Reduced Planck's constant, nucleon magnetic moments, nuclear stability, nuclear binding energy, nuclear mass and neutron lifetime, it is planned to confirm the physical existence of the proposed 585 GeV weak fermion. **Results**: All proposed logics and formulae clearly establish the physical existence of 585 GeV weak fermion directly and indirectly. **Conclusion**: Believing in the physical existence of the proposed 585 GeV weak fermion, there is a scope for observing galactic TeV radiation coming by virtue of annihilation of 585 GeV fermions and radiation associated with various astrophysical acceleration mechanisms of 585 GeV fermions. **Appeal**: As we are beginners of astrophysics domain, we appeal the science community to see the possibility of considering the proposed 585 GeV weak fermion with a charge of $(\pm e)$ in place of electron and proton.

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1. Introduction

It is generally believed that, electrons and nucleons are fermions and are responsible for the observed spectrum of electromagnetic radiation that propagates in the form of photons. At sub nuclear level, it is well established that, quarks are fermions and play a vital role in generating baryons and mesons. Gluons are believed to be the force carriers between quarks and hadrons. Here we would like to emphasize the point that, whether it is electromagnetic interaction or strong interaction, fermions are supposed to be the 'field generators' and photons and gluons are believed to be the 'force carriers'. It is very clear to say that, 'field generators' and 'force carriers' both are essential elements in understanding their respective interactions and both can be considered as a representation of 'head' and 'tail' of a coin. Coin 'without head' or 'without tail' – is practically an ambiguous physical issue. In this context, with reference to the well believed and well understood 'weak' interaction [1,2] – we sincerely appeal that,

1) There is a scope for understanding weak interaction with its 'weak field generating fermion'.
2) There exists a 'weak field fermion' corresponding to the currently believed three weak bosons.

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In this context, in our recently proposed '4G model of final unification' associated with three large atomic gravitational constants pertaining to the three atomic interactions [3–16], we have proposed the existence of a weak fermion of rest energy 585 GeV. Considering the basic concepts of super symmetry [17–23], one can think about the possible existence of weak fermion. Here it seems important to mention the historical literature for the introduction of large gravitational constants by Nobel laureates and other scientists. In 1970s to 1990s, for understanding strong interactions, K. Tenakone, J.J.Perng, K.P. Sinha, Usha Raut, C. Sivaram, V. de Sabbata, S. I. Fisenko, M. M. Beilinson, B. G. Umanov, Abdus Salam, J. Strathdee, E. Recami, V. Tonin-Zanchin, Sergey G. Fedosin, O.F. Akinto and Farida Tahir proposed the existence of nuclear gravitational constant having a very large magnitude [24–32]. Thus, we have developed our model and quantified the magnitude of the strong nuclear gravitational constant [33–37]. In 2013, for understanding weak interactions, Roberto Onafrio, proposed the existence of weak gravitational constant having a large magnitude [38,39]. E. A. Pashitskii and V. I. Pentegov further extended the subject [40]. Motivated with these large coupling constants, for understanding the electromagnetic interactions, we have proposed the existence of another large gravitational constant [41,42].

Considering our 4G model of Final unification and its 3 assumptions, in our early and recent publications we have developed many relations in nuclear and particle physics. In this paper, we review the key nuclear relations that help in understanding and confirming the physical existence of our proposed 585 GeV electroweak fermion. Proceeding further, we show the possibility of confirming the physical existence of 585 GeV weak fermion with reference to the observed tera electron volt (TeV) photon radiation coming from astrophysical objects.

Starting from section 2 to section 14, directly and indirectly, we are showing different possible nuclear applications and evidences for understanding and confirming the physical existence of 585 GeV weak fermion. In section 15, including the Fermi's weak coupling constant and Newtonian gravitational constant, we have developed a procedure for estimating and fitting the fundamental physical constants. In section 16, we have outlined the mechanism of understanding and confirming the physical existence of the proposed weak fermion via galactic TeV photons. We have proposed our conclusions in section 17.

2. Three Assumptions, Five Definitions and Many Applications

Our way of approach is completely different from current models of unified physics and it may take some time for its understanding, implementation and review. We would like to emphasize the point that, compared to String theory [43–46], our approach is very simple, elegant and workable. It may be noted that, even though there is mathematical beauty and good physics towards the unification of gravity and atomic interactions, String theory is not able to estimate and fit the fundamental physical constants. Proceeding further, its predictions are beyond the scope of current engineering and technology. Roger Penrose and other scientists are very unhappy with the multiple and impractical solutions of String theory. In this context, readers are encouraged to visit the URL: https://www.youtube.com/watch?v=q1ubpGylbWs. One important aspect of our approach is to widen the scope and applicability of String theory towards the three atomic interactions with testable predictions and possible experimental designs [47]. Readers are encouraged to work on the data presented in Table 1 and Table 2.

Table 1. Charge dependent string tensions and energies.

S.No	Interaction	String Tension	String energy
1	Weak	$\frac{c^4}{4G_w} \cong 6.94\times10^{10}$ N	$\sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_w}\right)} \cong 24.975$ GeV

2	Strong	$\frac{c^4}{4G_n} \cong 6.065\times10^4$ N	$\sqrt{\frac{e_n^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_n}\right)} \cong 68.79$ MeV
3	Electromagnetic	$\frac{c^4}{4G_e} \cong 8.505\times10^{-5}$ N	$\sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_e}\right)} \cong 874.3$ eV

Table 2. Quantum string tensions and energies.

S.No	Interaction	String Tension	String energy
1	Weak	$\frac{c^4}{4G_w} \cong 6.94\times10^{10}$ N	$\sqrt{\hbar c\left(\frac{c^4}{4G_w}\right)} \cong 292.36$ GeV
2	Strong	$\frac{c^4}{4G_n} \cong 6.065\times10^4$ N	$\sqrt{\hbar c\left(\frac{c^4}{4G_n}\right)} \cong 273.3$ MeV
3	Electromagnetic	$\frac{c^4}{4G_e} \cong 8.505\times10^{-5}$ N	$\sqrt{\hbar c\left(\frac{c^4}{4G_e}\right)} \cong 10234.77$ eV

In our 4G model of final unification, there exists 3 assumptions, 5 definitions and many inferences. Considering the proposed assumptions and definitions, we have presented various applications in nuclear physics. We would like to emphasize the point that, with reference to the current knowledge of physics, so far, no physics model has shown such a wide range of applications in a unified approach. It may be noted that, as per the current notion of standard model of particle physics, weak interaction neither involves in forming particle bound states and nor in particle binding energy scheme. An interesting point of our research is that weak interaction plays a vital role in understanding the origins of quantum mechanics, nuclear stability and binding energy. Weakness of our model is: 1) Lack of mathematical approach; 2) Missing links between the proposed relations; Here, we would like to highlight the point that understanding fundamental things in a broad view is not so simple and certainly beyond the scope of human thinking and imagination. We are sure that, with further research and fine tuning, things can be improved in a phased manner, and the four fundamental branches of physics can be understood in a better way.

3. Three Assumptions of 4G Model of Final Unification

Following our 4G model of final unification, we proposed the following assumptions.

1) There exists a characteristic electroweak fermion of rest energy, $M_{wf}c^2 \cong 584.725$ GeV. It can be considered as the zygote of all elementary particles.

2) There exists a nuclear elementary charge in such a way that, $\left(\frac{e}{e_n}\right)^2 \cong \alpha_s \cong 0.1151935$ = Strong coupling constant [48,49] and $e_n \cong 2.946362e$.

3) Each atomic interaction is associated with a characteristic large gravitational coupling constant. Their fitted magnitudes are,

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$G_e \cong$ Electromgnetic gravitational constant $\cong 2.374335 \times 10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$

$G_n \cong$ Nuclear gravitational constant $\cong 3.329561 \times 10^{28}\ \text{m}^3\ \text{kg}^{-1}\text{sec}^{-2}$

$G_w \cong$ Electroweak gravitational constant $\cong 2.909745 \times 10^{22}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$

Based on these fits,

a) Considering the ratio of Planck scale to the nuclear scale, Newtonian gravitational constant [50–53] can be fitted with, $G_N \cong \dfrac{G_w^{21} G_e^{10}}{G_n^{30}} \cong 6.679851 \times 10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$.

b) On interpreting or eliminating the large numbers, neutriono rest mass [7,54,55] can be inferred as, $m_{xf} \cong \left(\dfrac{\sqrt{G_w G_N}}{G_n}\right) M_{wf} \cong \left(\dfrac{m_e^6}{m_p^5}\right)$. Thus, $m_{xf} \cong 4.365 \times 10^{-47}\ \text{kg} \cong 2.45 \times 10^{-11}\ \text{eV}/c^2$.

c) Strong coupling constant [49] can be fitted with, $\alpha_s \cong \dfrac{G_w^6 G_e^4}{G_n^{10}} \cong 0.115193455$.

d) Independent of system of units, Avogadro like large number [56–59] can be fitted with a relation of the form, $\dfrac{\text{Product of short range gravitational constants}}{\text{Product of long range gravitational constants}} \cong \dfrac{G_n G_w}{G_N G_e} \cong \dfrac{G_n^{31}}{G_w^{20} G_e^{11}} \cong 6.1088144 \times 10^{23}$.

e) Neutron lifetime [7,60–64] can be fitted with, $t_n \cong \dfrac{G_e^2 m_n^2}{G_w \left(m_n - m_p\right) c^3} \cong 874.94$ sec. It seems that, outside the nucleus, neutron experiences electromagnetic interaction and weak interaction helps neutron to decay into proton, electron and neutrino.

f) Characteristic atomic radii [7,65–70] can be addressed with $R_{atom} \cong A^{1/3}\left(\dfrac{2\sqrt{G_n G_e} M_U}{c^2}\right) \cong A^{1/3} \times 32.86$ pm where A represents the mass number and $M_U \cong 931.5\ \text{MeV}/c^2$ represents the unified atomic mass unit. Starting from the 3rd period, $R_{atom} \cong \left\{\left[4 - \left(\dfrac{A}{Z}\right)\right]\left(\dfrac{Z_{fp}}{Z}\right)^2\right\}\left[A^{1/3}\left(\dfrac{2\sqrt{G_n G_e} M_U}{c^2}\right)\right]$ where Z represents the atomic number and Z_{fp} represents the atomic number of the first element of the period. It needs further study and fine tuning.

g) Bohr radius of hydrogen atom can be addressed with, $a_0 \cong \left(\dfrac{4\pi\varepsilon_0 G_n m_p}{e^2 c^2}\right)\left(G_e m_e^2\right)$. Energy conservation point of view, it can be expressed as, $\dfrac{G_e m_e^2}{a_0} \cong \dfrac{e^2}{4\pi\varepsilon_0 \left(G_n m_p / c^2\right)}$. It may be noted that, as per the current models, there is no solid interconnection between nuclear charge radius and Bohr radius.

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4. Interaction Ranges Associated with the 3 Atomic Interactions and the Scope for 4G Model of String Theory

By following the above assumptions, it is possible to estimate the three atomic interaction ranges in the following way.

Electroweak interaction range can be expressed as,

$$R_w \cong \frac{2G_w M_{wf}}{c^2} \cong 6.7494 \times 10^{-19} \text{ m} \quad (1)$$

Nuclear interaction range can be expressed as,

$$R_n \cong \frac{2G_n m_p}{c^2} \cong 1.2393 \times 10^{-15} \text{ m} \quad (2)$$

Electromagnetic interaction range can be expressed as,

$$R_e \cong \frac{2G_e m_e}{c^2} \cong 4.813 \times 10^{-10} \text{ m} \quad (3)$$

Here, we would like to highlight the following two points.

1) Proposed weak interaction range, $\frac{2G_w M_{wf}}{c^2} \cong \sqrt{\frac{G_F}{\hbar c}}$ where G_F is the Fermi's weak coupling constant [1,2,52,53].
2) String theory [43–45] can be made practical with reference to the three atomic gravitational constants associated with weak, strong and electromagnetic interaction gravitational constants. See Table 1. and Table 2. for sample string tensions [46] and energies without any coupling constants.

5. Our 5 Definitions Related to Final Unification

In a unified approach, we have defined 5 relations in the following way.

Electron rest mass is defined as,

$$m_e \equiv \left(\frac{G_w}{G_n}\right) M_{wf} \quad (4)$$

Proton rest mass is defined as,

$$m_p \equiv \left(\frac{G_n^2}{G_e G_w}\right) M_{wf} \quad (5)$$

Nuclear and electromagnetic charge ratio is defined as

$$\left(\frac{e}{e_n}\right) \equiv \frac{\hbar c}{G_n m_p^2} \quad (6)$$

Product of Reduced Planck's constant and speed of light is defined as

$$\hbar c \equiv G_w M_{wf}^2 \quad (7)$$

Ratio of forces related to proton and electron is defined as

$$\frac{e_n^2}{4\pi\varepsilon_0 G_n m_p m_e} \equiv 4\pi^2 \quad (8)$$

6. Understanding the Reduced Planck's Constant and Its Integral Nature

Based on relation (7), the well believed quantum constant $\hbar c$ seems to have a deep inner meaning with reference to electroweak interaction. Following relation (7), there is a possibility to understand the integral nature of quantum mechanics with a relation of the form,

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$n^2\hbar \equiv \frac{G_w\left(nM_{wf}\right)^2}{c}$ where $n = 1,2,3,..$ Compared to large massive structures, -like living creatures- as elementary particles are having discrete nature, we would like to emphasize the point that, discreteness may be the root cause of quantum behavior at microscopic level. With reference to proton and electron rest masses, it seems possible to have different relations like,

$$\hbar \cong \left(\frac{e}{e_n}\right)\left(\frac{G_n m_p^2}{c}\right) \cong \frac{G_w M_{wf}^2}{c} \cong \frac{G_n M_{wf} m_e}{c}$$

$$\cong \left(\frac{G_w G_e}{G_n}\right)\frac{m_p m_e}{c} \cong \frac{m_e\sqrt{\left(G_n m_p\right)\left(G_e m_e\right)}}{c} \quad (9)$$

We would like to emphasize the point that, at first, one should understand the origin of the quantum constants. Then only, one may be able to understand the potential consequences of the quantum constants. Integral nature, wave nature, particle nature, position and momentum - all these physical properties seem to be inherently connected with the generation of the quantum constant. Including string theory, current physical models are simply inserting the quantum constant $\hbar$ and trying to understand the consequences. It needs further study with reference to EPR argument and other physical logics [10,71–74]. We are working in this new direction.

7. Understanding Proton-Electron Mass Ratio

Considering weak, nuclear and electromagnetic interactions,

$$\frac{m_p}{m_e} \cong \frac{G_n^3}{G_w^2 G_e} \quad (10)$$

Strong coupling constant [48,49] can be expressed as,

$$\alpha_s \cong \left(\frac{e}{e_n}\right)^2 \cong \left(\frac{\hbar c}{G_n m_p^2}\right)^2 \cong \frac{G_e m_e^3}{G_n m_p^3} \cong \frac{G_w^6 G_e^4}{G_n^{10}} \quad (11)$$

Hence, proton and electron mass ratio can be expressed as,

$$\frac{m_p}{m_e} \cong \frac{e_n^2 G_e m_e^2}{e^2 G_n m_p^2} \cong \left(\frac{e_n^2}{4\pi\varepsilon_0 G_n m_p^2}\right) \div \left(\frac{e^2}{4\pi\varepsilon_0 G_e m_e^2}\right)$$

$$\cong \left(\frac{e_n^2 G_e}{e^2 G_n}\right)^{1/3} \cong \left[\left(\frac{e_n^2}{4\pi\varepsilon_0 G_n}\right) \div \left(\frac{e^2}{4\pi\varepsilon_0 G_e}\right)\right]^{1/3} \quad (12)$$

In terms of specific charge ratios,

$$\left(\frac{e}{m_e}\right) \div \left(\frac{e_n}{m_p}\right) \cong \frac{e m_p}{e_n m_e} \cong \frac{\hbar c}{G_n m_p m_e} \cong \frac{G_e m_e^2}{\hbar c} \cong \sqrt{\frac{R_e}{R_n}} \cong \frac{G_w G_e}{G_n^2} \cong \frac{M_{wf}}{m_p} \quad (13)$$

$$\left(\frac{e_n}{m_p}\right) \div \left(\frac{e}{m_e}\right) \cong \frac{e_n m_e}{e m_p} \cong \frac{G_n m_p m_e}{\hbar c} \cong \frac{\hbar c}{G_e m_e^2} \cong \sqrt{\frac{R_n}{R_e}} \cong \frac{G_n^2}{G_w G_e} \cong \frac{m_p}{M_{wf}} \cong 0.001605 \quad (14)$$

Here it is very interesting to note that,

$$\frac{m_p}{M_{wf}} \cong \left(\frac{\sqrt{\left(m_\pi c^2\right)^0 \left(m_\pi c^2\right)^\pm}}{\sqrt{\left(m_w c^2\right)^\pm \left(m_z c^2\right)^0}}\right) \cong \left(\frac{\sqrt{134.98 \times 139.57}\ \text{MeV}}{\sqrt{80379.0 \times 91187.6}\ \text{MeV}}\right) \cong 0.0016032 \quad (15)$$

Here ratio of rest mass of proton to the assumed electroweak fermion is equal to the ratio of mean mass of pions to the mean mass of electroweak bosons. Based on this unique and concrete observation, we are very confident to say that strong and weak interactions play a vital role exploring the secrets of nuclear structure.

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8. Understanding the Nucleon Magnetic Moments

Characteristic nucleon magnetic moment having a nuclear charge of e_n and electromagnetic charge of e can be expressed as,

$$\mu_X \cong \frac{\hbar\sqrt{e_n e}}{2m_p} \cong \frac{e\hbar}{2\sqrt{m_e M_{wf}}} \cong 8.6696\times10^{-27}\ \text{J.Tesla}^{-1}$$

$$\text{where } M_{wf} \cong 1.042367\times10^{-24}\ \text{kg} \qquad (16)$$

Neutron magnetic moment [52,53] can be fitted with,

$$\mu_n \cong (1+\alpha_s)\frac{\hbar\sqrt{e_n e}}{2m_p} \cong (1+\alpha_s)\frac{e\hbar}{2\sqrt{m_e M_{wf}}} \cong 9.6684\times10^{-27}\ \text{J.Tesla}^{-1} \qquad (17)$$

Proton magnetic moment [52,53] can be fitted with,

$$\mu_p \cong (1.5+\alpha_s)\frac{\hbar\sqrt{e_n e}}{2m_p} \cong \frac{e\hbar}{2\sqrt{m_e M_{wf}}} \cong 1.40\times10^{-26}\ \text{J.Tesla}^{-1} \qquad (18)$$

Ratio of neutron and proton magnetic moments can be expressed as,

$$\frac{\mu_n}{\mu_p} \cong \frac{(1.0+\alpha_s)}{(1.5+\alpha_s)} \cong 0.69 \qquad (19)$$

9. Understanding the Fermi's Weak Coupling Constant

Fermi's weak coupling constant [1,2,52,53] can be fitted with the following relations.

$$G_F \cong \left(\frac{m_e}{m_p}\right)^2 \hbar c R_n^2 \cong \hbar c R_w^2$$

$$\cong G_w M_{wf}^2 R_w^2 \cong 1.440206\times10^{-62}\ \text{J.m}^3 \qquad (20)$$

It is a very simple relation and demonstrates the confirmation of the physical existence of the proposed 585 GeV weak fermion. Obtained value is matching with the recommended value by 99.7%. It needs further study. In terms of electromagnetic, nuclear and gravitational interactions confined to radius of $R_n \cong \frac{2G_n m_p}{c^2} \cong 1.2393\times10^{-15}\,\text{m}$, G_F can be expressed as,

$$G_F \cong \left[\left(G_e^2 G_N\right)^{\frac{1}{3}} m_p^2\right]\left(\frac{2G_n m_p}{c^2}\right)^2 \qquad (21)$$

10. Understanding Nuclear Stability Associated with Beta Decay

Nuclear stability means, finding stable atomic nuclides having long living time compared to other living atomic nuclides having short living time. By beta decay, mostly short living atomic nuclides emit electrons and positrons transform to stable atomic nuclides. In general, Beta decay process is believed to be associated with weak interaction. In this context, we noticed that, starting from Z=2 to 92,

$A_s \cong 2Z + \beta(2Z)^2 \cong 2Z + 4\beta Z^2 \cong 2Z + 0.00642Z^2$

where,

$A_s \cong$ Light house like stable mass number

$Z \cong$ Proton number

$\beta \cong$ Specific charge ratios of proton and electron

$$\cong \left(\frac{e_n}{m_p}\right) \div \left(\frac{e}{m_e}\right) \cong \frac{e_n m_e}{e m_p} \cong \sqrt{\frac{R_n}{R_e}} \cong \frac{m_p}{M_{wf}} \cong 0.001605$$

$$4\beta \cong 4 \times 0.001605 \cong 0.00642 \quad (22)$$

Here we wish to call β as the electroweak coefficient. Thus,

$$\frac{A_S - 2Z}{4Z^2} \cong \beta \quad (23)$$

One can find a similar relation in the literature [75]. This relation can be well tested for Z=21 to 92. For example,

$$\frac{45-(2\times 21)}{4(21)^2} \cong 0.00170; \quad \frac{63-(2\times 29)}{4(29)^2} \cong 0.00149;$$

$$\frac{89-(2\times 39)}{4(39)^2} \cong 0.00181; \quad \frac{109-(2\times 47)}{4(47)^2} \cong 0.0017;$$

$$\frac{169-(2\times 69)}{4(69)^2} \cong 0.00163; \quad \frac{238-(2\times 92)}{4(92)^2} \cong 0.001595;$$

This is one best practical and quantitative application of our proposed electroweak fermion and bosons. Following this relation and based on various semi empirical mass formulae, by knowing any stable mass number, its corresponding proton number can be estimated with,

$$Z \cong \frac{A_S}{1+\sqrt{1+4\beta A_S}} \cong \frac{A_S}{1+\sqrt{1+0.00642A_S}} \cong \frac{A_S}{2+0.0153A_S^{2/3}} \quad (24)$$

where $\frac{a_c}{2a_{asy}} \cong \frac{0.71 \text{ MeV}}{2\times 23.21 \text{ MeV}} \cong \frac{0.6615 \text{ MeV}}{2\times 21.6091 \text{ MeV}} \cong 0.0153$

With even-odd corrections and further study, super heavy atomic nuclides can be estimated easily. In this context, we have developed the following relation.

$$A_s \cong \text{RoundOff}\left\{\left(Z+\left(\frac{e_n}{e}\right)\right)^{1.2} - \sqrt{\frac{e_n}{e}}\right\} \cong \text{RoundOff}\left\{(Z+2.9464)^{1.2} - 1.7165\right\}$$

$$\text{where } \left(\frac{e_n}{e}\right)^{\frac{1}{6}} \cong \left(\frac{1}{\alpha_s}\right)^{\frac{1}{12}} \cong 1.19733 \cong 1.2 \quad (25)$$

With even odd corrections,

$$A_s \cong \left[\text{RoundOff}\left\{(Z+2.9464)^{1.2} - 1.7165\right\} + [0,1]\right] \quad (26)$$

Here,

1) If Z is even and obtained A_s is odd, then, $A_s \cong A_s + 1$.
2) If Z is even and obtained A_s is even, then, $A_s \cong A_s$.
3) If Z is odd and obtained A_s is odd, then, $A_s \cong A_s$.
4) If Z is odd and obtained A_s is even, then, $A_s \cong A_s + 1$.

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See Table. 3 presented in the next section for the estimated light house like stable mass numbers and corresponding nuclear binding energy.

Table 3. Estimated nuclear binding energy of *Z*=6 to 118 at light house like mass numbers.

Z	A	N	As	A_free	A_radial	EBE (MeV)	EBEPN (MeV)	RBE (MeV)	RBEPN (MeV)	Dif. BE (MeV)
6	12	6	12	0.67	2.29	91.3	7.6	85.4	7.1	-5.9
7	15	8	15	0.74	2.47	119.1	7.9	109.4	7.3	-9.7
8	16	8	16	0.81	2.52	128.0	8.0	122.0	7.6	-5.9
9	19	10	19	0.90	2.67	155.9	8.2	147.3	7.8	-8.6
10	20	10	20	0.98	2.71	164.7	8.2	159.1	8.0	-5.6
11	23	12	23	1.09	2.84	192.6	8.4	185.1	8.0	-7.5
12	24	12	24	1.19	2.88	201.2	8.4	196.1	8.2	-5.1
13	27	14	27	1.32	3.00	229.1	8.5	222.6	8.2	-6.5
14	28	14	28	1.44	3.04	237.5	8.5	233.0	8.3	-4.6
15	31	16	31	1.59	3.14	265.3	8.6	259.8	8.4	-5.5
16	32	16	32	1.73	3.18	273.6	8.6	269.5	8.4	-4.1
17	35	18	35	1.90	3.27	301.3	8.6	296.6	8.5	-4.7
18	38	20	38	2.08	3.36	328.8	8.7	326.8	8.6	-2.0
19	39	20	39	2.24	3.39	337.0	8.6	333.0	8.5	-4.0
20	42	22	42	2.45	3.48	364.4	8.7	363.2	8.6	-1.2
21	43	22	43	2.63	3.50	372.4	8.7	368.8	8.6	-3.5
22	46	24	46	2.85	3.58	399.6	8.7	399.0	8.7	-0.6
23	49	26	49	3.09	3.66	426.7	8.7	425.3	8.7	-1.4
24	50	26	50	3.30	3.68	434.5	8.7	434.3	8.7	-0.2
25	53	28	53	3.56	3.76	461.4	8.7	460.7	8.7	-0.8
26	56	30	56	3.84	3.83	488.2	8.7	489.8	8.7	1.6
27	57	30	57	4.06	3.85	495.8	8.7	495.4	8.7	-0.4
28	60	32	60	4.36	3.92	522.4	8.7	524.5	8.7	2.0
29	63	34	63	4.68	3.98	548.9	8.7	550.0	8.7	1.1
30	66	36	66	5.01	4.04	575.2	8.7	578.3	8.8	3.1
31	67	36	67	5.26	4.06	582.6	8.7	584.1	8.7	1.5
32	70	38	70	5.61	4.12	608.7	8.7	612.2	8.7	3.5
33	73	40	73	5.98	4.18	634.7	8.7	637.1	8.7	2.4
34	74	40	74	6.25	4.20	641.9	8.7	645.6	8.7	3.7
35	77	42	77	6.64	4.25	667.7	8.7	670.4	8.7	2.7
36	80	44	80	7.05	4.31	693.3	8.7	697.7	8.7	4.4
37	83	46	83	7.48	4.36	718.7	8.7	721.9	8.7	3.2
38	84	46	84	7.77	4.38	725.7	8.6	730.3	8.7	4.5
39	87	48	87	8.21	4.43	751.0	8.6	754.4	8.7	3.4
40	90	50	90	8.67	4.48	776.1	8.6	781.0	8.7	4.9
41	93	52	93	9.15	4.53	801.1	8.6	804.6	8.7	3.5

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42	94	52	94	9.47	4.55	807.8	8.6	812.7	8.6	4.9
43	97	54	97	9.97	4.60	832.6	8.6	836.2	8.6	3.6
44	100	56	100	10.49	4.64	857.2	8.6	862.2	8.6	5.0
45	103	58	103	11.02	4.69	881.7	8.6	885.2	8.6	3.5
46	106	60	106	11.57	4.73	905.9	8.5	910.6	8.6	4.7
47	107	60	107	11.91	4.75	912.4	8.5	916.0	8.6	3.5
48	110	62	110	12.48	4.79	936.5	8.5	941.3	8.6	4.7
49	113	64	113	13.07	4.84	960.5	8.5	963.7	8.5	3.3
50	116	66	116	13.67	4.88	984.2	8.5	988.5	8.5	4.3
51	119	68	119	14.29	4.92	1007.9	8.5	1010.6	8.5	2.7
52	122	70	122	14.93	4.96	1031.3	8.5	1034.9	8.5	3.6
53	123	70	123	15.31	4.97	1037.5	8.4	1040.2	8.5	2.7
54	126	72	126	15.96	5.01	1060.7	8.4	1064.4	8.4	3.7
55	129	74	129	16.64	5.05	1083.8	8.4	1085.9	8.4	2.1
56	132	76	132	17.32	5.09	1106.8	8.4	1109.8	8.4	2.9
57	135	78	135	18.03	5.13	1129.6	8.4	1130.9	8.4	1.3
58	138	80	138	18.75	5.17	1152.3	8.3	1154.3	8.4	2.1
59	141	82	141	19.48	5.21	1174.7	8.3	1175.1	8.3	0.3
60	142	82	142	19.90	5.22	1180.5	8.3	1182.6	8.3	2.1
61	145	84	145	20.66	5.25	1202.8	8.3	1203.3	8.3	0.5
62	148	86	148	21.44	5.29	1224.9	8.3	1226.1	8.3	1.3
63	151	88	151	22.22	5.33	1246.9	8.3	1246.5	8.3	-0.4
64	154	90	154	23.03	5.36	1268.7	8.2	1269.0	8.2	0.3
65	157	92	157	23.85	5.40	1290.3	8.2	1288.9	8.2	-1.4
66	160	94	160	24.69	5.43	1311.8	8.2	1311.1	8.2	-0.8
67	163	96	163	25.54	5.46	1333.2	8.2	1330.7	8.2	-2.5
68	166	98	166	26.41	5.50	1354.4	8.2	1352.6	8.1	-1.8
69	167	98	167	26.88	5.51	1359.6	8.1	1357.4	8.1	-2.2
70	170	100	170	27.77	5.54	1380.6	8.1	1379.1	8.1	-1.5
71	173	102	173	28.67	5.57	1401.4	8.1	1398.3	8.1	-3.1
72	176	104	176	29.59	5.60	1422.1	8.1	1419.6	8.1	-2.5
73	179	106	179	30.53	5.64	1442.6	8.1	1438.5	8.0	-4.1
74	182	108	182	31.48	5.67	1463.0	8.0	1459.5	8.0	-3.5
75	185	110	185	32.45	5.70	1483.2	8.0	1478.1	8.0	-5.1
76	188	112	188	33.43	5.73	1503.3	8.0	1498.8	8.0	-4.4
77	191	114	191	34.43	5.76	1523.2	8.0	1517.1	7.9	-6.0
78	194	116	194	35.45	5.79	1542.9	8.0	1537.5	7.9	-5.4
79	197	118	197	36.48	5.82	1562.5	7.9	1555.6	7.9	-6.9
80	200	120	200	37.53	5.85	1581.9	7.9	1575.7	7.9	-6.3
81	203	122	203	38.59	5.88	1601.2	7.9	1593.4	7.8	-7.8
82	206	124	206	39.66	5.91	1620.3	7.9	1613.2	7.8	-7.1
83	209	126	209	40.76	5.93	1639.3	7.8	1630.7	7.8	-8.6

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84	212	128	212	41.87	5.96	1658.1	7.8	1650.3	7.8	-7.9
85	215	130	215	42.99	5.99	1676.8	7.8	1667.5	7.8	-9.3
86	218	132	218	44.13	6.02	1695.3	7.8	1686.7	7.7	-8.6
87	219	132	219	44.71	6.03	1699.4	7.8	1691.0	7.7	-8.4
88	222	134	222	45.87	6.06	1717.7	7.7	1710.1	7.7	-7.6
89	225	136	225	47.05	6.08	1735.9	7.7	1726.9	7.7	-8.9
90	228	138	228	48.24	6.11	1753.9	7.7	1745.7	7.7	-8.1
91	231	140	231	49.45	6.14	1771.7	7.7	1762.3	7.6	-9.4
92	234	142	234	50.67	6.16	1789.4	7.6	1780.9	7.6	-8.5
93	237	144	237	51.91	6.19	1806.9	7.6	1797.2	7.6	-9.7
94	240	146	240	53.17	6.21	1824.3	7.6	1815.4	7.6	-8.8
95	243	148	243	54.44	6.24	1841.5	7.6	1831.5	7.5	-9.9
96	246	150	246	55.72	6.27	1858.5	7.6	1849.5	7.5	-9.0
97	249	152	249	57.02	6.29	1875.4	7.5	1865.4	7.5	-10.1
98	252	154	252	58.34	6.32	1892.2	7.5	1883.1	7.5	-9.1
99	255	156	255	59.67	6.34	1908.8	7.5	1898.7	7.4	-10.1
100	258	158	258	61.02	6.37	1925.2	7.5	1916.2	7.4	-9.0
101	261	160	261	62.39	6.39	1941.5	7.4	1931.6	7.4	-9.9
102	264	162	264	63.76	6.42	1957.6	7.4	1948.8	7.4	-8.8
103	269	166	269	65.88	6.46	1986.3	7.4	1975.3	7.3	-11.0
104	272	168	272	67.30	6.48	2002.0	7.4	1992.2	7.3	-9.8
105	275	170	275	68.74	6.50	2017.6	7.3	2007.0	7.3	-10.5
106	278	172	278	70.19	6.53	2033.0	7.3	2023.7	7.3	-9.2
107	281	174	281	71.66	6.55	2048.2	7.3	2038.3	7.3	-9.9
108	284	176	284	73.14	6.57	2063.3	7.3	2054.8	7.2	-8.5
109	287	178	287	74.63	6.60	2078.3	7.2	2069.2	7.2	-9.1
110	290	180	290	76.15	6.62	2093.1	7.2	2085.4	7.2	-7.7
111	293	182	293	77.67	6.64	2107.7	7.2	2099.6	7.2	-8.2
112	296	184	296	79.22	6.66	2122.2	7.2	2115.6	7.1	-6.7
113	299	186	299	80.78	6.69	2136.5	7.1	2129.5	7.1	-7.1
114	302	188	302	82.35	6.71	2150.7	7.1	2145.3	7.1	-5.5
115	305	190	305	83.94	6.73	2164.7	7.1	2159.0	7.1	-5.8
116	308	192	308	85.54	6.75	2178.6	7.1	2174.5	7.1	-4.1
117	311	194	311	87.17	6.78	2192.3	7.0	2188.0	7.0	-4.3
118	314	196	314	88.80	6.80	2205.9	7.0	2203.3	7.0	-2.5

11. Understanding Nuclear Binding Energy

In our recent publications pertaining to 4G model of final unification and based on strong and electroweak interactions, we have developed a completely new formula for estimating nuclear binding energy [76–80]. With reference to currently believed Semi Empirical Mass Formula (SEMF), we call our formula as 'Strong and Electroweak Mass Formula' (SEWMF). Our formula constitutes 4 simple terms and only one energy coefficient of magnitude 10.1 MeV. First term is a volume term, second term seems to be a representation of free nucleons associated with electroweak interaction,

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third term is a radial term and fourth one is an asymmetry term about the mean stable mass number. Considering this kind of approach, nuclear structure can be understood in terms of strong and weak interactions in a theoretical approach positively [1–16]. For Z=6 to 118, improved binding energy relation can be expressed as follows. This relation and its corresponding paper is in review.

$$BE \cong \left(A - A_{free} - A_{radial} - A_{asym}\right)\left(B_0 \cong 10.1 \text{ MeV}\right) \quad (27)$$

where $A \times 10.1 \text{ MeV}$ represents the volume term

$A_{free} \times 10.1 \text{ MeV}$ represents the modified electroweak term

$A_{radial} \times 10.1 \text{ MeV}$ represents the radial term

$A_{asym} \times 10.1 \text{ MeV}$ represents the modified asymmetry term

$$B_0 \cong -\frac{e_n^2}{8\pi\varepsilon_0\left(G_n m_p / c^2\right)} \cong -10.1 \text{ MeV}$$

$$\cong \frac{1}{2}\left[\left(2m_u c^2 + m_d c^2\right) + \left(m_u c^2 + 2m_d c^2\right)\right] \cong 10.1 \text{ MeV}$$

where (m_u, m_d) reprsent Up and Down quark masses.

$$BE \cong \left\{ A - \left\{ \sqrt{\left(\frac{1}{2}\right) + \beta\left[\left(Z^2 + N^2 + \left(\frac{Z^2}{N}\right)^2\right) - N^2\left(\frac{N-Z}{N+Z}\right)^2\right]} \right\} - A^{1/3} - \frac{\left(A_s - A\right)^2}{A_s} \right\} 10.1 \text{ MeV}$$

where, $\beta \cong 0.001605$

(28)

Extrapolation point of view, there is a considerable error for very low and very high mass numbers of any Z and we are working in all possible ways. Close to the light house like stable mass numbers of Z=6 to 118,

$$BE \cong \left\{ A_s - \left\{ \sqrt{\left(\frac{1}{2}\right) + 0.001605\left[\left(Z^2 + N^2 + \left(\frac{Z^2}{N}\right)^2\right) - N^2\left(\frac{N-Z}{N+Z}\right)^2\right]} \right\} - A_s^{1/3} \right\} 10.1 \text{ MeV} \quad (29A)$$

We are working on understanding the electroweak term in various possible ways. See the following Table. 3 for the estimated binding energy of Z=6 to 118 with light house like mass numbers estimated from relation (26). For data comparison, we have taken the following advanced binding energy formula presented in reference [78].

$$BE \cong \left\{ \begin{array}{l} \left\{\left[1 + \left(\frac{4k_v}{A^2}\right)\left|T_z\right|\left(\left|T_z\right| + 1\right)\right] a_v * A\right\} + \left\{\left[1 + \left(\frac{4k_s}{A^2}\right)\left|T_z\right|\left(\left|T_z\right| + 1\right)\right] a_s * A^{\frac{2}{3}}\right\} \\ + \left\{a_c * \left(\frac{Z^2}{A^{1/3}}\right)\right\} + \left\{f_p * \frac{Z^2}{A}\right\} + E_p \end{array} \right\} \quad (29B)$$

where, $T_z \cong \text{3rd component of isospin} = \frac{1}{2}(Z - N)$

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$$\left\{\begin{array}{l} a_v = -15.4963 \text{ MeV}, a_s = 17.7937 \text{ MeV} \\ k_v = -1.8232, k_s = -2.2593 \\ a_c = 0.7093 \text{ MeV}, f_p = -1.2739 \text{ MeV} \\ d_n = 4.6919 \text{ MeV}, d_p = 4.7230 \text{ MeV} \\ d_{np} = -6.4920 \text{ MeV} \end{array}\right\} \text{ and } \left\{\begin{array}{l} \text{for } (Z, N) \text{ Odd, } E_p \cong \frac{d_n}{N^{1/3}} + \frac{d_p}{Z^{1/3}} + \frac{d_{np}}{A^{2/3}} \\ \text{for } (\text{Odd } Z, \text{ Even } N), E_p \cong \frac{d_p}{Z^{1/3}} \\ \text{for } (\text{Even } Z, \text{ Odd } N), E_p \cong \frac{d_n}{N^{1/3}} \\ \text{for } (\text{Even } Z, \text{ Even } N), E_p \cong 0 \end{array}\right\}$$

In Table 3,
As= Estimated light house like stable mass number
EBE = Estimated binding energy in MeV
EBEPN = Estimated binding energy per nucleon in MeV
RBE= Reference binding energy in MeV
RBEPN = Reference binding energy per nucleon in MeV
Diff.BE= Difference in Reference and Estimated binding energy.

Based on Liquid drop model, close to beta stability line, number of free nucleons associated with nuclear volume and surface area, can be addressed with an approximate relation of the form,

$$\begin{aligned} A_{free} &\cong \frac{1}{2} + \left[0.000634 \left(\left(\underline{A + Z^{2/3} + N^{2/3}} \right)^2 + \left(\frac{2Z}{A} \right) \left(\frac{Z^2}{N} \right)^2 \right) \right] \\ &\cong \frac{1}{2} + \left[0.000634 \left(\left(\underline{\left(\overline{Z + Z^{2/3}}\right) + \left(\overline{N + N^{2/3}}\right)} \right)^2 + \left(\frac{2Z}{A} \right) \left(\frac{Z^2}{N} \right)^2 \right) \right] \end{aligned} \quad (30)$$

where $\beta \left(\frac{m_e}{m_n - m_p} \right) \cong \frac{m_p m_e}{M_{wf} \left(m_n - m_p \right)} \cong 0.000634$

12. Understanding the Mean Lifetime of Neutron

Ratio of neutron-proton mass difference to electron rest mass can be expressed as,

$$\left.\begin{array}{l} \left(\frac{m_n - m_p}{m_e} \right) \cong \ln(4\pi) \cong 2.531024247 \text{ and} \\ \frac{(939.5654205 - 938.27208816) \text{ MeV}}{0.51099895 \text{ MeV}} \\ \cong \frac{1.2933324 \text{ MeV}}{0.51099895 \text{ MeV}} \cong 2.530988371 \end{array}\right\} \quad (31)$$

Relation (31) can be understood with the following relation (32). It may be noted that, $\frac{e^2 G_n m_p^3}{4\pi\varepsilon_0 (\hbar/2)^2} \cong \frac{4e^2 G_n m_p^3}{4\pi\varepsilon_0 \hbar^2} \cong 80.693732 \text{ MeV}$. With a marginal error, it is matching with twice of the potential depth of nucleon (40 MeV) associated with Fermi gas model [81,82] of the nucleus.

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$$\left.\begin{aligned}&\text{Let,}\left(\frac{m_n-m_p}{m_e}\right)\cong\ln\sqrt{\left(\frac{e^2G_nm_p^3}{4\pi\varepsilon_0\left(\hbar/2\right)^2}\right)\div\left(m_ec^2\right)}\\&\cong\ln\sqrt{\frac{4e^2m_p}{4\pi\varepsilon_0\hbar m_ec}\left(\frac{G_nm_p^2}{\hbar c}\right)}\cong\ln\sqrt{\frac{4e_n^2m_p}{4\pi\varepsilon_0\hbar m_ec}\left(\frac{\hbar c}{G_nm_p^2}\right)}\\&\cong\ln\sqrt{\left(\frac{4e_n^2}{4\pi\varepsilon_0G_nm_pm_e}\right)}\cong\ln\sqrt{4\left(\frac{e_n^2}{4\pi\varepsilon_0G_nm_pm_e}\right)}\\&\cong\ln\sqrt{4\left(4\pi^2\right)}\cong\ln\sqrt{16\pi^2}\cong\ln\left(4\pi\right)\end{aligned}\right\}\quad(32)$$

Considering $\hbar$ in place of $(\hbar/2)$, $\frac{e^2G_nm_p^3}{4\pi\varepsilon_0\hbar^2}\cong 20.173433$ MeV.

If $\frac{e^2G_nm_p^3}{4\pi\varepsilon_0\hbar^2}\cong\frac{e_n^2}{4\pi\varepsilon_0\left(G_nm_p/c^2\right)}\cong 20.173433\text{ MeV}$ represents a kind of potential energy, its total energy form is, $-\frac{e^2G_nm_p^3}{8\pi\varepsilon_0\hbar^2}\cong-\frac{e_n^2}{8\pi\varepsilon_0\left(G_nm_p/c^2\right)}\cong-10.08672\text{ MeV}$. Based on these coincidences, bottle method of neutron lifetime [60–64] can be expressed as,

$$\left.\begin{aligned}&t_n\cong\exp\left[\frac{2\times\text{Nucleon potential well}\left(\approx 40\text{ MeV}\right)}{\left(\text{Neutron, Proton}\right)\text{ rest energy difference}}\right]\left(\frac{\hbar}{m_nc^2}\right)\\&\cong\exp\left[\frac{e^2G_nm_p^3}{4\pi\varepsilon_0\left(\hbar/2\right)^2\left(m_n-m_n\right)c^2}\right]\left(\frac{\hbar}{m_nc^2}\right)\\&\cong\exp\left[4\left(\frac{e_n^2}{4\pi\varepsilon_0\left(G_nm_p/c^2\right)}\right)\left(\frac{1}{\left(m_n-m_n\right)c^2}\right)\right]\left(\frac{\hbar}{m_nc^2}\right)\\&\text{where factor '4' needs a review for its physical interpretation}\end{aligned}\right\}.\quad(33)$$

Thus, it is possible to show that,

$$\begin{aligned}&t_n\cong\exp\left[\left(\frac{m_e}{m_n-m_p}\right)\left(\exp\left(\frac{m_n-m_p}{m_e}\right)\right)^2\right]\left(\frac{\hbar}{m_nc^2}\right)\cong 871.04\text{ sec}\\&\cong\exp\left[\frac{16\pi^2}{\ln\left(4\pi\right)}\right]\left(\frac{\hbar}{m_nc^2}\right)\cong 874.174\text{ sec.}\end{aligned}\quad(34)$$

Now coming back to our nuclear stability and binding energy relations, we noticed that,

$$\left(1+\frac{e_n}{e}\right)\left(\frac{m_p}{M_{wf}}\right)\cong 0.0063340\cong\left(\frac{1}{4\pi}\right)^2\cong 0.0063326\quad(35)$$

If one is willing to replace the factor 4 with $\left(1+\frac{e_n}{e}\right)\cong 3.9464$ in relation (22), nuclear beta stability relation can be expressed as,

$$A_s\cong 2Z+\left(\frac{Z}{4\pi}\right)^2\quad(36)$$

13. Understanding the Root Mean Square Radius of Proton and Nuclear Charge Radii

Root mean square radius of proton [83,84] can be understood with

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$$R_p \cong \left(1+\frac{e_n}{e}\right)\left(\frac{\hbar}{m_p c}\right) \cong \left(\frac{\hbar}{m_p c}\right)+\left(\frac{G_n m_p}{c^2}\right)$$
$$\cong \left(1+\frac{e}{e_n}\right)\left(\frac{G_n m_p}{c^2}\right) \cong 8.3\times 10^{-16}\ \text{m} \quad (37)$$

Considering higher powers of $\left(\frac{e}{e_n}\right)$,

$$R_p \cong \exp\left(\frac{e}{e_n}\right)\left(\frac{G_n m_p}{c^2}\right) \cong 1.4041\left(\frac{G_n m_p}{c^2}\right) \quad (38)$$

Thus,

$$R_p \cong (1.3394 \text{ to } 1.4041)\left(\frac{G_n m_p}{c^2}\right) \cong (8.3 \text{ to } 8.7)\times 10^{-16}\ \text{m} \quad (39)$$

For medium and heavy atomic nuclides, nuclear charge radii [85–87] can be expressed as,

$$R_{(Z,N)} \cong \left[Z^{1/3}+\left(\sqrt{ZN}\right)^{1/3}\right]\left(\frac{G_n m_p}{c^2}\right)$$
$$\cong \left[Z^{1/3}+\left(\sqrt{ZN}\right)^{1/3}\right]\times 0.6197\times 10^{-15}\ \text{m} \quad (40)$$

Estimated data can be compared with the data available at https://www-nds.iaea.org/radii/ and http://zgwlc.xml-journal.net/fileZGWLC//journal/article/file/6bed4d71-97cc-4f48-9f0f-20af839757da.txt. See Table. 4 (attached at the end of the paper). Estimated data has been compared with the data presented in reference [86], https://www-nds.iaea.org/radii/.

Thus, by knowing the nuclear charge radii, nuclear gravitational constant [24–37] can be estimated as,

$$G_n \cong \left[Z^{1/3}+\left(\sqrt{ZN}\right)^{1/3}\right]^{-1}\left(\frac{c^2 R_{(Z,N)}}{m_p}\right) \quad (41)$$

This relation can be thoroughly investigated and modified for a better understanding and accuracy for the whole range of atomic nuclides.

14. Understanding Various Quantum Constants

Believing in these simple and workable relations, Planck's constant and corresponding magnetic flux quantum [5,52,53] can be expressed as follows.

$$h \cong \sqrt{\left(\frac{e_n^2}{4\pi\varepsilon_0 c}\right)\left(\frac{G_e m_e^2}{c}\right)} \quad (42)$$

$$\left(\frac{h}{e}\right) \cong \left(\frac{e_n}{e}\right)\sqrt{\frac{G_e m_e^2}{4\pi\varepsilon_0 c^2}} \cong \left(\frac{e_n}{e}\right)\sqrt{\frac{\mu_0}{4\pi}\left(G_e m_e^2\right)} \quad (43)$$

With reference to experimental magnetic flux quantum $\left(\frac{h}{2e}\right)$, factor $\left(\frac{1}{2}\right)$ is missing in this relation. It can be understood as follows.

Total magnetic flux generated for one electron can be,

$$\Phi_{Total} \cong \left(\frac{e_n}{e}\right)\sqrt{\left(\frac{\mu_0}{4\pi}\right)G_e m_e^2} \cong \frac{h}{e} \quad (44)$$

For a simple two-pole system, quantum of magnetic flux per pole can be,

$$\Phi_{per/pole} \cong \frac{\Phi_{Total}}{2} \cong \frac{1}{2}\left(\frac{e_n}{e}\right)\sqrt{\left(\frac{\mu_0}{4\pi}\right)G_e m_e^2} \cong \frac{h}{2e} \quad (45)$$

Following this logic, quantum of resistance can be expressed as,

$$\frac{h}{e^2} \cong \left(\frac{e_n}{e}\right)\left(\frac{m_e}{e}\right)\sqrt{\frac{G_e}{4\pi\varepsilon_0 c^2}} \quad (46)$$

We are working in this direction.

15. Discussion on Estimating the Newtonian Gravitational Constant, the Proposed Weak Gravitational Constant and the Charge Ratio

In a unified approach, Newtonian gravitational constant can be estimated with many relations. Based on atomic interferometry, its experimental value seems to vary in a wide range of (6.672 to 6.693) x 10^{-11} cubic meters per kilogram second squared [88–90]. Based on relation (21),

$$G_N \cong \frac{G_F^3 c^{12}}{64 G_e^2 G_n^6 m_p^{12}} \cong \frac{G_F^3}{G_e^2 m_p^6}\left(\frac{2G_n m_p}{c^2}\right)^{-6} \cong \frac{G_F^3}{G_e^2 m_p^6 R_0^6}$$

$$\text{where } R_0 \cong \frac{2G_n m_p}{c^2} \cong 1.2393\times10^{-15}\text{ m} \quad (47)$$

If the recommended value [52,53] of $G_F \cong 1.435851032\times10^{-62}$ J.m^3, estimated value of $G_N \cong 6.61938\times10^{-11}$ m^{3}kg^{-1}sec^{-2}.

Considering relation (20), obtained value of $G_F \cong 1.440206\times10^{-62}$ J.m^3 and estimated value of $G_N \cong 6.679794\times10^{-11}$ m^{3}kg^{-1}sec^{-2}.

With reference to the recommended value [52,53] of $G_N \cong 6.6743\times10^{-11}$ m^{3}kg^{-1}sec^{-2} and based on our proposed relations (20), (21) and (47), values of G_F and G_N are closely fitting with each other. This kind of approach can be recommended for further research.

Here it may be noted that, based on the relations (8) and (11)

$$G_e \cong \left(\frac{m_p}{2\pi m_e}\right)^2 \frac{e^2}{4\pi\varepsilon_0 m_e^2} \quad (48)$$

Thus, with reference to the known nuclear and atomic physical constants and their accuracy,

$$G_N \cong \left(\frac{m_e}{m_p}\right)^8 \left(\frac{4\pi\varepsilon_0}{e^2}\right)^2 \frac{16\pi^4 G_F^3}{m_p^2 R_0^6} \cong \left(\frac{m_e}{m_p}\right)^{10}\left[\left(\frac{4\pi\varepsilon_0}{e^2}\right)^2 \frac{16\pi^4 G_F^3}{m_e^2 R_0^6}\right] \quad (49)$$

Interesting observation is that,

$$G_w \cong \left(\frac{4\pi\varepsilon_0}{e^2}\right)^2 \frac{16\pi^4 G_F^3}{m_e^2 R_0^6}$$

$$\cong \text{Proposed Weak gravitational constant} \quad (50)$$

Thus, $$\frac{G_N}{G_w} \cong \left(\frac{m_e}{m_p}\right)^{10} \text{ (or) } \frac{G_w}{G_N} \cong \left(\frac{m_p}{m_e}\right)^{10} \quad (51)$$

Based on relations (6), (10), (11), (20) and (21),

$$\frac{\hbar c}{G_n m_p^2} \cong \frac{e}{e_n} \cong \frac{G_w^3 G_e^2}{G_n^5} \cong \left(\frac{G_n^{15} G_N}{G_w^{12} G_e^4}\right)^{\frac{1}{3}} \quad (52)$$

Unification point of view, relations (21), (50), (51) and (52) need a thorough study.

Based on relations (7), (20), (21), (42), (43), (48) and (51), quantitatively,

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$$\frac{e_n}{e} \cong \frac{4\pi^2 m_e}{\alpha\ m_p} \cong \frac{m_p^2}{M_{wf} m_e} \quad (53)$$

Proceeding further, Strong coupling constant can be expressed as,

$$\alpha_s \cong \left(\frac{e}{e_n}\right)^2 \cong \frac{M_{wf}^2 m_e^2}{m_p^4} \quad (54)$$

Thus, in a unified data fitting approach,

1) **Step-1:** After a systematic study and understanding of nuclear charge radii, from relation (41), (G_n) and $\left(G_n m_p/c^2\right),\left(2G_n m_p/c^2\right)$ can be estimated.
2) **Step-2:** From relation (6), $\left(\frac{e_n}{e}\right)$ can be estimated.
3) **Step-3:** From relation (11), (α_s) can be estimated.
4) **Step-4:** From relation (53), (M_{wf}) can be estimated.
5) **Step-5:** From relation (7), (G_w) can be estimated.
6) **Step-6:** From relation (52), (G_e) and (G_N) can be estimated.
7) **Step-7:** From relation (20) or (21), (G_F) be estimated.
8) **Step-8:** With further study, all obtained values can be verified for their estimated accuracy with reference to relations like (8), (9), (10), (37 to 39) and (42 to 51).
9) **Step-9:** A cyclic review on Step-1 to Step-8
10) **Step-10:** To standardize the obtained numerical values, eliminating unwanted relations, exploring new relations, developing a cohesive and workable physical model.

See Table 4. (attached at the end of the paper), for the estimated data based on the reference nuclear charge radii [86]. In this attempt, we consider elementary charge, permittivity of free space, proton and electron rest masses and reduced Plank's constat as inputs. All the estimated values are in SI units. It may be noted that, in a verifiable approach, we consider the fundamental ratio $\left(\frac{h}{\hbar}\right) \cong 2\pi$ as a cross-check value. In the first row of Table 4, we have presented the average values of the estimated physical constants corresponding to 890 nuclear charge radii. For the time being, it can be considered as a case study.

16. Tera Electron Volt Photon Radiation Coming from Galaxies

In the near future, by increasing the operating capacity of particle accelerators it seems possible to confirm the existence of 585 GeV. It can be understood by observing Tera electron volt (TeV) photons coming by annihilation of 585 GeV fermions within the core of the particle accelerator or surroundings of astrophysical objects. At the vicinity of compact stars or exploding stars, TeV radiation can be understood with three theoretical methods [91–95]. As we are beginners of astrophysics domain, we appeal the science community to see the possibility of considering the proposed 585 GeV weak fermion with a charge of $(\pm e)$ in place of electron and proton. As it is assumed that, 585 GeV weak fermion is the mother of all elementary particles, at very high energies, it can be assumed as relatively stable for the possible occurrence of the following accelerating mechanisms.

Method-1: Generation and Annihilation of 585 GeV Weak Fermions

a) 585 GeV fermions are generated by the decay of high energy elementary particles available within the core of the hot astrophysical objects.
b) 585 GeV weak fermions emit high energy radiation via annihilation mechanism.

Method-2: Annihilation of Accelerated 585 GeV Weak Fermions

a) 585 GeV fermions are forced to accelerate by the surrounding shock waves.
b) Accelerated 585 GeV weak fermions emit high energy photons via synchrotron mechanism or annihilation.

Method-3: Accelerated 585 GeV Weak Fermions Sharing Energy to Low TeV Photons

a) 585 GeV fermions are forced to accelerate by the surrounding shock waves.
b) By following Inverse Compton Effect (ICE), low TeV photons gain energy from high energy 585 GeV weak fermions resulting in much higher TeV photons.

17. Conclusion

Even though our approach is lagging in mathematical approach and links are missing in developing a perfect model, compared to string theory, following our approach, there is a possibility of understanding and fitting the fundamental constants and there is a scope for developing unified physical concepts in a better way. In a microscopic approach, considering relations (1) to (54), it seems possible to understand and confirm the physical existence of the proposed 585 GeV weak fermion directly and indirectly. We would like to emphasize the point that the "ratio of mean mass of pions to the mean mass of weak bosons" is accurately matching with the "ratio of mass of proton to the proposed weak fermion". It can be considered as a strong support and evidence for confirming the physical existence of the proposed weak fermion. In a macroscopic approach, by considering TeV photons coming from astrophysical objects, there is a scope and possibility for confirming the physical existence of 585 GeV weak fermion. It needs further study.

Data availability statement: The data that support the findings of this study are openly available.

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